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Assessment, Inventory and Ethnobotanical Survey of Medicinal Plants in Batan and Sabtang Island (Batanes Group of Islands, Philippines)

Ruby Raterta[1]*, Gerard Q. de Guzman[1,2] and Grecebio Jonathan D. Alejandro[1,3]

[1]The Graduate School, University of Santo Tomas, Espana, Manila, 1015, Philippines

[2]Virgen Milagrosa University Foundation, San Carlos City, 2420 Philippines

[3]College of Science and Research Center for the Natural and Applied Sciences,
University of Santo Tomas, Espana, Manila, 1015, Philippines

*Corresponding Author E-mail: bhieya02@yahoo.com

ABSTRACT

The Batanes group of islands in the northern Philippine archipelago presents some of the most diversed flora in the country. This study is an assessment and inventory including ethnobotanical and alkaloid field survey of medicinal plants in Batanes, particularly in the islands of Batan and Sabtang. Sixty-eight plants were randomly collected from 6 vegetation areas. Plants photographs and voucher specimens were identified for species richness, diversity and alkaloid contents. Twenty-one respondents were asked using a structured questionnaire about the self-anecdotal uses of the 68 plants under 9 disease categories. The 68 plant collections represented 35 families dominated by Rubiaceae, Rutaceae, Asclepiadaceae, Fabaceae, Malvaceae and Moraceae. Endemic, introduced, ornamental, invasive and economically-important plants were identified. In most cases, there is a good correlation between species richness and diversity indices. Among the plants surveyed for anecdotal uses, Morinda citrifolia L. registered the highest use reports at 13, giving an informant consensus factor and fidelity level values of 1.0 and 100% for its application in cardio-metabolic diseases. Morinda citrifolia L., Psidium gujava L., Catharantus roseus G. Don and Datura metel L. gave the highest use values. The leaves, prepared as decoction, were the most commonly used plant part to cure ailments. The plants with high alkaloid contents include Datura metel L., Catharantus roseus L., Pandanus sp. and Argemone mexicana L. This study was able to give the diversity, anecdotal therapeutic uses and alkaloid contents of medicinal plants in the islands of Batan and Sabtang in the province of Batanes, Philippines.

***Key words**: Medicinal plants, Batanes province, ethnobotanical survey.*

INTRODUCTION

The Batanes group of islands in the northernmost part of the Philippine archipelago (Figure 1) is a center of plant diversity with 529 species, 49 of which were reported to be endemic[10]. This may be due to the warm and rainy climate and the wide variety of vegetation types. Abe and Ohtani[1] conducted an ethnobotanical study of plants in Batan island; however, no plant assessment or inventory was carried out. This study assessed richness and diversity of medicinal plants in Batan and Sabtang islands, confirmed the previous ethnobotanical survey on important disease categories and incorporated alkaloid contents of the medicinal plants which was previously conducted by Aguinaldo et al. and Guevara[2,5].

Fig.1: The 3 Largest Islands in Batanes, Philippines: Batan, Sabtang and Itbayat

MATERIALS AND METHODS

Sixty-eight specimens were collected by random sampling for 2 weeks in the limestone hills in Chadpidan in Basco, the bushy grasslands in the Uyugan shoreline, the grassy hilly landscape in the 450 meters high Mt. Matarem, the bushy grassland 1,000 meter summit of Mt. Iraya - all of which are located in Batan islands; and the *Scaveola* – dominated beach of Ivuhos and the montane dipterocarp forest and grassy hills in Chavayan, both of which are in Sabtang islands. Collected plants in the field were pressed in between newspapers and treated with denatured alcohol for vouchers.

In the laboratory, the specimens were soaked in 100 mL of 95% ethanol-phenol (60:40) and subsequently oven-dried[9]. Properly oven-dried specimens were mounted in herbarium sheets with official label. Herbarium specimens were submitted to the Philippine National Herbarium (PNH) and the University of Santo Tomas Herbarium (USTH) for confirmation and/or identification. For alkaloid contents, results from the alkaloid field survey of Aguinaldo et al. and Guevara[2,5] were cited in this study.

There were 21 respondents in the informal interviews of different healers and other local residents aged 21 to 90. They were selected by chance as no appointments were made prior to the interviews. Preference for female respondents was made on the basis of their higher knowledge on the anecdotal therapeutic uses of plants than their male counterparts in the communities surveyed ($p < 0.05$). In this study, 10 out of the 21 respondents have formal college education and the rest are high school or elementary levels. This finding is important since the respondents may already have previous knowledge on the therapeutic uses of any of the 68 plants collected and the proper way by which these plants must be prepared. Fourteen of the respondents are based in Sabtang island while 7 respondents lived in Batan island where the capital town of Basco is located. Most respondents were chosen from Sabtang islands as no plant assessments and ethnobotanical surveys were conducted in this area that has a diverse vegetation in both montane forests and the shorelines.

A semi-structured questionnaire was used to determine the informant's knowledge of diseases indicated for the plants collected as used by the locals through interview, showing whole plant photographs and their modes of preparation and administration. Surveys are limited to 9 disease categories out of the 13 major disease classifications recognized by the World Health Organization[17].

RESULTS AND DISCUSSIONS

1. Species Richness

The 68 plants collected belong to 35 families which are dominated by Asteraceae (n = 6) followed by Zingiberaceae (n = 5) and then Rubiaceae, Rutaceae, Asclepiadaceae, Fabaceae, Malvaceae and Moraceae (registering 4 plants each). Surprisingly, Apocynaceae, Lamiaceae and Solanaceae were scarcely represented even if several common plants of pantropical distribution from these families have been observed during the actual collection process and, thus, contradicting the findings of Abe and Ohtani[1]. These observations implies that species richness is not representative of the whole population. Families that were left unsurveyed include Arecaceae, Anacardiaceae and Poaceae.

2. Plant Status

Most of the 68 plants sampled are shrubs (n = 25) and herbs (n = 25), followed by trees (n = 14) and vines (n = 4). Mean tree height is 5.7 meters (RSD = 1.2%) while mean tree high diameter is 72 centimeters (RSD = 5.7%).

Uvaria sorsogonensis Presl. was found to be endemic to the Philippines while *Artemisia japonica* Burm. is believed to have been newly introduced to Batanes. *Carmona retusa* Vahl., a highly-established medicinal plant, was found to be invasive. Five ornamental plants were identified, namely: *Begonia* sp., *Pandanus odoratissimus* L.f., *Catharantus roseus* G. Don., *Lantana camara* L., and *Cucurligo* sp. *Anisomeles indica* Kuntze is used as a pesticide. Two *Alpinia* sp. are cultivated for their volatile oil contents while *Cassia tora* Roxb. is cultivated as a food additives. *Asclepsias* sp. and *Pipturus aborescens* Link. are propagated as animal food sources. *Hibiscus tiliaceus* L. is used for handicraft making while *Ficus ampelas* cf. is used in the sandpaper industry.

3. Diversity of Plants

Table 1 gives both species richness and diversity data on different vegetation types surveyed in both Batan and Sabtang islands.

Table 1: Species Richness and Diversity in Various Vegetation Types

Vegetation Type	Species Richness N = 68	Diversity Indices		
		Simpson's	Shannon's	Dominance
Limestone Hills (Chadpidan)	25.00%	0.14	3.91	0.86
Fish Cage Farms (Mahatao)	17.60%	0.11	3.88	0.83
Bushy Grasslands (Uyugan)	13.20%	0.1	3.76	0.82
Scaveola Shoreline (Sabtang)	11.80%	0.12	3.77	0.77
Grassy Hills (Mt. Matarem)	10.30%	0.12	3.64	0.71
Montane Forest (Sabtang)	10.30%	0.11	3.51	0.68
Bushy Grasslands (Mt. Iraya)	4.40%	0.02	2.87	0.32
Montane Forest (Uyugan)	4.40%	0.02	2.65	0.33
Basco Town Proper	2.90%	0.01	2.51	0.19

It is evident that there is a high agreement between species richness and the different diversity indices ($r < 0.80$) in all vegetation types. The high species richness and diversity obtained in the limestone hills is due to the presence of thick densed montane dipterocarp forests. On the other hand, the purely grassy plains in the agro-ecosystem of Basco town proper has limited plants and, thus, low species richness and diversity indices obtained in this area. The low species and diversity counts in Mt. Matarem and Mt. Iraya, both characterized as purely grasslands, is also due to the absence of montane forests.

Plant assessment is important when ethnobotanical studies are done simultaneously since species richness and diversity may influence the use values (UV) of certain plants for certain ailment, category of a disease, or multiple indications for multiple disease states.

4. Ethnobotanical Studies

The 21 respondents gave information on the medicinal uses of the 68 plants collected for each disease category surveyed. Every time a plant is used to any extent in each disease category, it was considered to be 1 use report. Table 2 tabulates the disease categories, informant consensus factor (ICF) and fidelity levels (FL).

Table 2: Disease Categories with Informant Consensus Factor (ICF) and Fidelity Levels (FL)

Disease Category	Most Frequently Used Plants	No. of Use Reports	No. of Species	ICF	% FL
Cardio-metabolic	*Morinda citrifolia* L.	13	5	1	100.00%
Infectious Diseases	*Pandanus tectorius* Park.	10	8	1	89.70%
Muscelo-skeletal	*Schefflera* sp.	7	4	0.5	47.50%
Gastro-intestinal (GIT)	*Carmona retussa* Vahl.	5	4	1	100.00%
Respiratory	*Datura metel* L.	5	3	1	100.00%
Genito-Urinary	*Phyllantus niruri* L.	4	2	0.4	94.50%
OB-Gynecology	*Ervatamia pandacaqui* Pichon	3	2	0.3	94.50%
Eyes, Ears, Nose, Throat	*Synedrella nodiflora* Gaert.	1	1	0.2	49.20%
Skin Diseases	*Senna alata* L.	1	1	0.1	32.20%

The ICF value (0 – 1.0) determines the agreement between informants over which plants should be used for each category of disease. The highest ICF value of 1.0 obtained for 4 disease categories indicates good precision in information exchange within a community. This is expected of *Morinda citrifolia*, the fruit of which has been used for hypertension, diabetes, dyslipidemia, gout and infectious diseases, encompassing 3 disease categories[18]. *Datura metel* has been used mainly for asthma and other pulmonary diseases due to its atropine content[8] but useful for applications in eye and genito-urinary diseases. *Phyllantus niruri* has been approved by the Philippine Food and Drug Authority (FDA) for use in kidney and gall bladder stones. Among the 68 plants collected, *Carmona retussa* and *Senna alata* have been identified by the FDA as essential herbal drugs[12].

Incidentally, except for infectious diseases, disease categories obtaining ICF values of 1.0 also gave 100.0 % Fl's. High FL values are obtained for plants most preferred species for a particular disease whereas low FL's are obtained for plants that are indicated for several diseases. High FL's are exemplified by *Carmona retussa* and *Datura metel* which are used only for GIT and respiratory diseases, respectively.

Table 3 lists 10 out of the 68 plants collected that gave the highest use values (UV). The UV of a plant provides a quantitative measure for the relative importance of the species locally. There is a high UV value when there are many use reports for a single plant without regards to the number of disease categories. Most plants listed in Table 3 are already common, indigenous and pantropical in distribution and well studied for their pharmacological properties and phytochemical constituents and, thus, the high UV's obtained. The high number of published articles on the therapeutic uses and bioactive substances of the first 4 plants may explain for their high UV's.

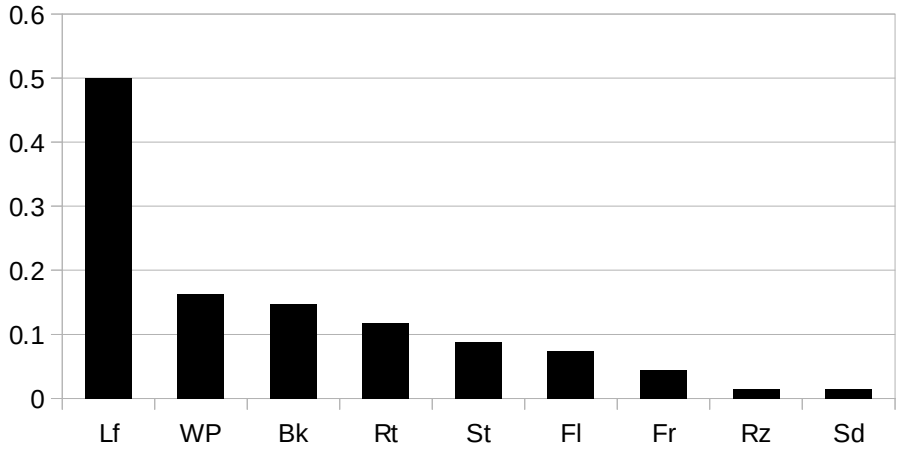
The respondents mentioned the use of decoction for 3 plants but did not have the idea that the use of excessive heat in their preparations will degrade bioactive substances present in these plants and, thus, attenuate their therapeutic effects. No mention was made on how poultices, emollients and rubifacients were prepared although the issue of cleaning and hygiene in their compounding must be observed. In most cases, the leaves are the most preferred plant part used.

Table 3: Plants with the Highest Use Values (N = 68)

Scientific Name	No. of Use Reports	No. of Categories	Use Value	Main Disease	Plant Part	Preparation
Morinda citrifolia L.	29	5	0.5	Diabetes	Fr./Lf	Aqueous Ext
Psidium guajava L.	28	5	0.42	Diabetes	Lf/Fr	Decoction
Catharantus roseus L.	19	4	0.31	Cancers	Lf/Rt	Infusion
Datura metel L.	17	4	0.22	Asthma	Lf/Fl	Decoction
Stachytarpheta jamaicensis Vahl.	11	3	0.19	Arthritis	Bk	Emollient
Phyllantus niruri L.	9	2	0.15	Stones	Lf	Infusion
Vernonia cinerea L.	8	2	0.15	Diarrhea	WP	Decoction
Melastoma malabathricum Smith	5	2	0.11	Fever	Lf/St	Poultice
Bidens pilosa L.	4	1	0.1	Wounds	WP	Tincture
Centella asiatica Urban	4	1	0.08	Arthritis	Lf	Rubifacient

Figure 2 shows the percentage by which different plant parts of the 68 plants collected are used by the locals as reported by the 21 respondents. Leaves were reportedly used by as much as 50% although there are cases where several parts of a plant are used as with the case of *Psidium guajava* (leaves and fruits) and the whole plants of *Bidens pilosa* and *Vernonia cinerea.* Most bioactive constituents of plants (i.e., alkaloids, polyphenols, sterols, polyketides) are concentrated in the leaves, barks and stem barks that is why most phytotherapy and phytochemical researches focus on these parts[4].

Figure 2: Plant Parts Used for Medicinal Purposes



Legend: Lf = leaves; WP = whole plant; Bk = barks; Rt = roots, St = stems; Fl = flowers; Fr = fruits; Rz = rhizomes and Sd = seeds

The respondents reported the use of leaves as decoction, 30.9%; infusion, 17.6%; poultice, 13.2%; fresh whole plant, 8.8%; and leaf sap, 1.5%. In this case, the leaf sap of *Melanolepsis multiglandulosa* was used for its antiseptic properties in wounds, as with the case of other plants belonging to the family Euphorbiaceae[4]. The rest of preparations were reported as follows: stem and bark decoctions, 17.6%; root decoction and infusion, 11.8%; fruit decoction and infusion, 11.8%; whole unripe fruit, 4.4%; rhizome decoction, 1.5% and seed poultice, 1.5%. Several plants require several types of preparations for different ailments. This is exemplified by *Psidium guajava*, the fruits, leaves and barks of which are compounded into several dosage forms to be use for diabetes mellitus, diarrhea, toothache, conjunctivitis

and wounds[7].

5. Alkaloid Field Survey

Alkaloids are heterocyclic nitrogenous compounds found in plants which precipitates in solution in the presence of reagents containing heavy metals. It is practical to consider alkaloids as toxic and having very potent pharmacological properties, although several of these substances have not yet been screened for certain therapeutic properties. Aguinaldo *et al*[2] reported the presence of alkaloids in plants collected from selected areas of Luzon island, representing mostly the Pandanaceae, Apocynaceae, Solanaceae and Convolvulaceae families. Recio and Madulid[13] reported the presence of alkaloids in 30 out of the 479 species of plants collected from Palawan island, representing mostly rare families, such as Aizoaceae, Celastraceae and Connaraceae.

Out of the 68 plants collected, 13 plants were found to contain alkaloids according to the alkaloid field survey of Aguinaldo et al[2] and Guevara[5]. Table 4 lists the plants that tested positive for the alkaloidal precipitants Mayer's and Dragendorff's TS. In most cases, the qualitative tests were more sensitive to Mayer's TS than with Dragendorff's TS. Those with a rating of only one (+) must be tested further, as the presence of quaternary nitrogenous bases may give false positive results. In some plants, it is interesting to note that alkaloids are concentrated in more than 1 part.

It is practical to anticipate positive results for plants belonging to Apocynaceae, Asteraceae, Solanaceae, Rubiaceae, Pandanaceae, Moraceae and Papaveraceae as these families are one of the world's top producer of alkaloids[4]. The leaves of *Datura metel* is priced for its atropine and hyosyamine which are used in the treatment of asthma, mushroom poisoning and GIT spasms[8].

Table 4: Plant Specimens Previously Identified to Contain Alkaloids[2,5]

Scientific Name	Family	Plant Part	Results	
			Mayer's TS	Dragendorff's TS
Ervatamia pandacaqui L.	Apocynaceae	Lf	+++	++
Centella asiatica Urban	Apiaceae	WP	++	+
Bidens pilosa L.	Asteraceae	WP	++	+
Datura metel L.	Solanaceae	Lf/Fl	++++	+++
Catharantus roseus L.	Apocynaceae	Lf/Fl/St	++++	+++
Morinda citrifolia L.	Rubiaceae	Fr/Lf	++	+
Phyllantus niruri L.	Phyllanthaceae	Lf	+	+
Vernonia cinerea L.	Asteraceae	WP	++	+
Pandanus sp.	Pandanaceae	Lf	++++	+++
Ficus septica Burm.	Moraceae	Lf/Bk	+	+
Melastoma malabathricum L.	Melastomataceae	Lf/St.	++	+
Anisomeles indica Kuntze	Lamiaceae	Lf	+	+
Argemone mexicana L.	Papaveraceae	Lf/Fr	++++	+++

Lf = leaves; WP = whole plant; Fl = flowers; St = stems; Bk = barks;
++++ = highly positive to + = fairly positive for alkaloids

The leaves of *Catharantus roseus* contains vincristine and vinblastine which are used during chemotherapy in leukemia[6]. The alkaloids from *Pandanus* sp. are widely studied although no reports on their therapeutic uses exist[15]. The presence of alkaloids in the fruit of *Morinda citrifolia* and the leaves of *Centella asiatica* confirmed the findings of de Guzman *et al*[3] and Sing *et al*,[14] respectively, although

reports on their isolation remains. There are no reports about the presence of alkaloids in *Bidens pilosa* but Okoli *et al*[11] have detected them in the leaves of this plant. Ervatamine from *Ervatamia pandacaqui* have antibacterial properties. Cell cultures of *Vernonia cinerea* is currently being investigated for alkaloid production[16]. Protomexicine is the newest alkaloid to be isolated from aerial part of *Argemone mexicana.*

CONCLUSION

This study confirms that plants are still valued for their medicinal purposes by the Ivatans in the Batanes province, given the fact that they have limited health facilities which are confined only in Basco, the capital town, in Batan island. The richness of plant species and their high diversity in Batan and Sabtang islands paved the way for the conduct of an ethnobotanical study which revealed the use values, consensus factors and fidelity levels of the 68 medicinal plants collected. Thirteen plants from 11 families were reported to contain alkaloids. It is recommended that more pharmacological screenings should be conducted to validate the anecdotal uses of these plants. Bioassay-guided isolation of the individual alkaloids is also warranted.

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